This presentation premiered at WaterSmart Innovations

watersmartinnovations.com





The New Validation Standard for AWWA Water Auditing



<u>Presenter</u>: Drew Blackwell Cavanaugh



AWWA Free Water Audit Software





Industry Standard (M36) Free

Defaults provided

~10 Volume Inputs ~7 System Data Inputs

awwa.org/waterlosscontrol



AWWA Free Water Audit Software[©] (V5.0) Data Grading

AWWA Free <u>Repo</u>	AWWA Free Water Audit Software: <u>Reporting Worksheet</u>								
? Click to access definition + Click to add a comment Water Audit Report for: << Please enter system details and contact information on the Instructions tab >> Reporting Year:									
Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades									
To select the correct data grading for each input, determine the the utility meets or exceeds <u>all</u> criteria for that grade an	To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds <u>all</u> criteria for that grade and all grades below it. Master Meter Error Adjustments								
WATER SUPPLIED Volume from own sources: + ? Water imported: + ? Water exported: + ? Water SUPPLIED:	 Indicating the second se	Dent: Value: nases/imports all of its water resources (i.e. has no g sources are estimated. No regular meter accuracy r sources estimated. No regular meter accuracy							
AUTHORIZED CONSUMPTION Billed metered: + ? Billed unmetered: + ? Unbilled metered: + ? Unbilled unmetered: + ?	 4. 50% - 75% of treated water production sources are metered, other testing or electronic calibration conducted. 5. Conditions between 4 and 6 6. At least 75% of treated water production sources are metered, or a metered sources. Meter accuracy testing and/or electronic calibration of than 25% of tested meters are found outside of +/- 6% accuracy. 7. Conditions between 6 and 8 9. 100% of tested meters are during a supersonal sources are metered. 	r sources estimated. Occasional meter accuracy at least 90% of the source flow is derived from of related instrumentation is conducted annually. Le							
Enter a positive value, otherwise a default percentage of 1.25% (of billed metere AUTHORIZED CONSUMPTION: ?	 instrumentation is conducted annually, less than 10% of meters are for 9. Conditions between 8 and 10 10. 100% of treated water production sources are metered, meter ac instrumentation is conducted semi-annually, with less than 10% found or reviewed by a third party knowledgeable in the M36 methodology. 	curacy testing and electronic calibration of related curacy testing and electronic calibration of related outside of +/- 3% accuracy. Procedures are							
WATER LOSSES (Water Supplied - Authorized Consumption)	0.000	value							
Apparent Losses Unauthorized consumption: + ? Default option selected for unauthorized consumption - a g	0.000 rading of 5 is applied but not displayed	Pcnt: ↓ Value: 0.25% ④ ○							
Customer metering inaccuracies: + ? Systematic data handling errors: + ?	0.000 0.000	1.00% ● ○ 0.25% ● ○							

AWWA Free Water Audit Software

Performance Indicators/Metrics

	AWWA Free Water Audit Software: WAS v5.0									
	System Attributes and Performance Indicators Copyright © 2014, All Rights Reserved.									
	Water Audit Report for: City of Orem (UT4900332)									
	Reporting Year: 2016 7/2015 - 6/2016									
	+ Real Losses: 555.653 MG/Yr									
	= Water Losses: 772.682 MG/Yr									
	? Unavoidable Annual Real Losses (UARL): 170.51 MG/Yr									
	Annual cost of Apparent Losses: \$233,740									
	Annual cost of Real Losses: \$213,979 Valued at Variable Production Cost									
	Return to Reporting Worksheet to change this assumption									
Performance Indicators:										
	Non-revenue water as percent by volume of Water Supplied: 14.8%									
Financial	Non-revenue water as percent by cost of operating system: 5.0% Real Losses valued at Variable Production Cost									
Γ	Apparent Losses per service connection per day: 26.11 gallons/connection/day									
On and Efficiency	Real Losses per service connection per day: 66.85 gallons/connection/day									
Operational Efficiency:	Real Losses per length of main per day*: N/A									
	Real Losses per service connection per day per psi pressure: 0.77 gallons/connection/day/psi									
	From Above, Real Losses = Current Annual Real Losses (CARL): 555.65 million gallons/year									
	Infrastructure Leakage Index (ILI) [CARL/UARL]: 3.26									
* This performance indicator appli	s for systems with a low service connection density of less than 32 service connections/mile of pipeline									

The BEST(?) Number

The BEST(?) Number



Data quality matters!

inaccuracy & inaccuracy & uncertainty in ----> uncertainty in inputs results

- Instruments
- Sources of Databases
 - error: People
 - Missing information

The Big Picture: Economic Intervention



Levels of Validation

Water audit validation aims to:

- Identify and correct errors
- Evaluate and communicate uncertainty
- Level 1 interview & summary records
- Level 2 deep data review
- Level 3 new data from the field



WRF #4372B:



WATER AUDITS IN THE UNITED STATES: A REVIEW OF DATA VALIDITY AND RESULTS

WRF #4639:

ESTABLISHING WATER UTILITY GUIDANCE AND METHODOLOGY FOR WATER AUDIT VALIDATION







WATER AUDITS IN THE UNITED STATES: A REVIEW OF DATA VALIDITY AND RESULTS

Data quality – the validity, or trustworthiness, of the data

Water Audit Results Across the Country

- Water Research Foundation 4372B
- many audits are **unrealistic**
 - more training (ie GA, TN) produces fewer unrealistic audits
 - even level 1 validation doesn't fully eliminate unrealistic audits

	СА	DRBC	GA	TN	ТХ
total audits	300	517	452	629	2,646
# of unrealistic audits	100	130	74	122	1,065
% of unrealistic audits	33%	25%	16%	19%	40%

sources of uncertainty:

- data source quality (primary measurement or secondary data management)
- methodology (use of the software, selection of data)

2016 UWMP Submitted Data - Unfiltered

		2016	2016	2016	
		n = 292	n = 292	n = 292	
	STATISTIC	min	median	тах	UNIT
ial	Customer Retail Unit Cost	\$0.00	\$3.93	\$180,097.61	\$ / 1,000 gal
Janc	Variable Production Cost	\$0.00	\$1,315.45	\$25,007,000.00	\$ / million gal
fir	NRW as % of Operating Cost	0.00%	3.54%	242305%	% of operating cost
	Apparent Losses	-4.34	6.36	122.3	gal/ serv conn / day
volumetric	Real Losses (serv conns)	-35	19.46	334.54	gal/ serv conn / day
	Real Losses (pressure)	-0.66	0.371	5.31	gal/ serv conn / day / psi
	ILI	-3.03	1.18	17.84	CARL / UARL
	Data Validity Score	2.35	75.33	98.27	points out of 100

WRF #4639:



ESTABLISHING WATER UTILITY GUIDANCE AND METHODOLOGY FOR WATER AUDIT VALIDATION

Data validation – a quality control process conducted to verify, and improve as needed, the data inputs and gradings of the water audits submitted by water utilities.

Water Loss Audit validation – does not make data inputs or gradings "right" or "wrong", but merely aligns them with the actual conditions that occurred in the operation of the utility for the audit year

- Level 1 -- Top down Data Review
- Level 2 -- Top down Data Mining Review
- Level 3 -- Bottom up Field Investigation

Purpose of Level 1 Validation

- 1) review of audit methodology and volume determination
- 2) review of Data Validity Grade selection

goals: quality and consistency

Purpose of Level 1 Validation

- 1) review of audit methodology and volume determination
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Level 1 Validation Tools:

- Discussion with Validator
- Supporting Documentation



Supporting Documentation

provides more detail on key values

REQUIRED	SUPPLEMENTAL			
Volume from Own Sources	Customer Meter Inaccuracy derivation			
broken down by month and meter \Box	Average Operating Pressure derivation			
broken down by month and meter	Customer Retail Unit Cost derivation			
Water Exported	Variable Production Cost derivation			
 Broken down by month and meter Supply Meter Testing 	System Schematic showing locations of Supply and Export Meters			
Volume of Metered Consumption broken down by month and charge code				

Required Supporting Documents are critical for Level 1 Validation



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Project 4639 (2016) Level 1 Water Audit Validation

Quick Facts

- Water audit validation is the process of examining water audit inputs to improve the water audit's accuracy and document the uncertainty associated with water audit data.
- Level 1 water audit validation confirms that American Water Works Association M36 water audit methodology was correctly applied to a utility's specific situation, identifies evident inaccuracies in summary water audit data, and verifies that data validity grades accurately reflect utility practices.
- While some uncertainty may persist in the water audit, the water audit is more reliable for having been Level 1 validated.







Level 1 Water Audit Validation

- FOCUS: accurate assignment of data grades correct application of audit methodology
- GOALS: confirm interpretation of methodology identify evident errors assign correct data grades
- **OUTCOMES:** *representative* data grades exist in the water audit recommendations for higher-level validation activity

LIMITATIONS: does not correct errors in raw data does not study instrument performance



Validation Outcomes



Validation Examples



Pre-Level **1** Validation Data Validity Score = 84 NRW Component Values

Total Cost of NRW =\$218,458

400,000 350,000 250,000 200,000 150,000 50,000 0

Leakage Index = 2.1

Level 1 Validation yielded a true-up of the Data Validity Score, and corrected macrolevel error that significantly change the volumes and values of audit outputs

Cost \$

Post-Level 1 Validation

Data Validity Score = 51

NRW Component Values

Total Cost of NRW =\$812,665



- Unbilled metered (valued at Var. Prod. Cost)
- Unbilled unmetered (valued at Var. Prod. Cost)
- Unauth. consumption
- Cust. metering inaccuracies
- Syst. data handling errors
- Real Losses (valued at Var. Prod. Cost)

Leakage Index = 2.1

Executive Summary

Level 1 Water Audit Validation



VALIDATION LEVEL	DEFINITION
self-reported	 Water audits have not been validated Water audit accuracy/reliability is not well understood
1	 Validated water audits have been examined for errors evident in summary data and application of methodology The data grades assigned to inputs accurately reflect utility practices
2	 Validated water audits have been corroborated with investigations of raw data and archived reports of instrument accuracy The best sources of data to inform the water audit have been identified
3	 Validated water audits have been bolstered by field tests of instrument accuracy Minimum night flow analysis and/or pilot leak detection supplement the water audit



Billing Data Analytics

Location ID	Jan 💌	Feb 💌	Mar 💌	Apr 💌	May 💌	Jun 🔻	Jul 🔻	Aug 🔻	Sep 💌	Oct 🔻	Nov _ ↑	Dec 💌	Total 🔻
42-87950	2	22	63	21	3	3	26	88	8	3	1	3	243
44-14300	20	10	10	4000	1010	1800			14	13	1	4	6882
30-89100	110	197	157	317	216	412	744	3451	2081	61	1	2	7749
13-70000	412	14		17	23	2	2	59		64	2		595
45-81700	458	536	558	456	440	394	447	509	558	1083	2	5	5446
10-33200		2	4		4	1143	5	2	2		3	316	1481
30-95900	233	291	203	258	221	260	258	304	269	216	4	51	2568
45-78000	400	479	426	378	411	315	356	480	519	52	5	4	3825
40-15000	283	357	365	278	465	338	282	667	348	307	6	232	3928
10-11850	1102	585		742	699	1017	664	771	700		9	1	6290
42-15640	324	363	310	306	482	381	397	576	421	135	10	18	3723
30-13400	2070	1431	204	243	64		191	26	6	4	13	2	4254
40-00840	372	4263	9786	950	1	1		8	93	88	16	16	15594
40-13900	549	643	697	461	653	535	570	772	316		17		5213
45-25100	107	39	32	57	23	51	35	41	76	27	26	28	542
43-80900	421	786	674	564	677	685	597	881	704	708	26	159	6882

Validation through Billing Data Analytics:

Outliers

Billing Data Analytics

Location ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-46900	327	465	255	487	1265	298	332	1440	-523	263	321	522
30-63500	555	900	526	793	831	1287	-222068	1714	2026	846	624	733
30-90200	430	343	320	508	618	832	-115743	789	750	361	341	365
33-00100	518	695	547	595	484	585	600	402		-35	435	723
33-46000	687	863	449	738	1594	952	-147178	1515	886	543	452	931
35-34700	227	281	207	220	212	-50023	235	379	602	247	214	263
40-13400	304	482	718	551	342	234	609	665	551	-57029	447	620
40-28500	275	875	495	432	563	535	571	1166	-57705	560	418	535
40-33200	492	532	544	435	645	520	510	1048	-66674	541	380	525
42-04300	435	523	401	495	425	644	470	606	578	536	-5363	531
42-05100	1395	2191	1472	1257	931	932	1475	1096	1730	792	-16681	1291

Validation through Billing Data Analytics: Negative Consumption

Billing Data Analytics

Account #	Jan	Mar	May	Jul	Sep	Nov	
07-0017-00-00	60	55	49	31	20	20	
10-2021-00-03	30	30	29	27	9	9	
10-6103-00-00	106	97	87	62	29	19	
10-6885-71-01	41	24	8	7	7	8	
11-1008-00-07	91	69	43	46	42	35	
12-8610-00-19	34	23	15	16	11	11	
13-1335-15-03	65	61	52	52	37	34	
13-1339-12-02	61	59	54	33	12	9	
06-0545-00-00	1050	811	353	170	386	280	

Validation through Billing Data Analytics:

Meter Degradation

Washington Pilot, 10 Systems, 9 Months

California

Full Scale, 460 Systems, 2 Years Water Audit Validation Training

Hawaii

Full Scale, 100 Systems, 4 Years

Colorado

Pilot, 50 systems Full Scale, 165 Systems, 2 Years

Utah

Pilot, 20 Systems, 6 Months

Wisconsin

Pilot, 6 Systems, 6 Months

Arizona

Pilot, 6 Systems, 6 Months Pilot, 25 Systems, 9 Months New Mexico

Full Scale, 134 Systems, 12 Months

Quebec

Water Audit Validation Training

North Carolina + South Carolina

Regional Basin, 19 Systems, Multi-year Pilot, 10 Systems, 12 Months

Georgia

Full Scale, 230 Systems, 5 Years Water Audit Validation Training Florida Pilot, 10 Systems, 12 Months

Water Loss Programs in North America



Registration is Open! www.awwa.org/waterloss

With Support From:







Local Host:



Kentucky/Tennessee Section



Drew Blackwell NRW Program Manager, Cavanaugh drew.Blackwell@cavanaughsolutions.com

